

INGUINAL HERNIA OF THE CÆCUM.

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COMPARATIVELY little has been written about inguinocæcal hernias by American and English surgeons. The cæcum forms the contents of a hernia with sufficient frequency and under such greatly different anatomical relations that further study of this subject is desirable to clear up several disputed points.

The cæcum is that portion of the large intestine lying below the entrance of the ileum. On an average it is two and one-half inches long and three inches wide. It may be much larger or smaller or may be congenitally absent. As a rule the cæcum does not have any direct connections, mesenteric or otherwise, with the abdominal parietes, but hangs from the ascending colon free in the abdominal cavity and is covered on all surfaces by peritoneum. The position of the cæcum, which varies greatly in different individuals, is determined chiefly by the position and attachments of the ascending colon.

A study of its development explains the variations in the anatomical relations of the ascending colon. For a time during early fetal life the greater part of the intestines lie within the umbilical cord, but between the seventh and ninth weeks they are drawn into the abdominal cavity. At this time the entire great intestine lies to the left of the median line. With the superior mesenteric artery as an axis, the cæcal end of the large intestine passes upward to the cardiac end of the stomach, across under the liver, and finally downward to reach the right iliac fossa about the eighth month of intra-uterine life.

The cæcum may be retained in the umbilical cord, forming

a congenital umbilical hernia, or it may be arrested permanently at any point along its normal circuit, or its direction may be diverted when it can occupy a position in the left iliac fossa, as in several cases collected by Lockwood. On the other hand, it may arrive at the iliac fossa as early as the fourth month.

During its period of development the ascending colon is provided with a mesentery, attached to the spine, in common with the small intestine. This primitive ascending mesocolon permits great mobility of the colon and may persist in adult life, as in two cases out of one hundred autopsies reported by Treves.

In the great majority of cases, however, the ascending colon loses its primitive mesocolon before birth and gains a secondary attachment to the posterior abdominal wall in the right lumbar region by a process of fusion (Fig. 1) between the posterior parietal peritoneum (*e, d*) and the superjacent leaflet of the primitive mesocolon (*a, b*). These two peritoneal layers then degenerate, forming areolar tissue or a thin fascial layer, and lose their identity as serous structures; and that leaflet of the primitive mesocolon (*a, c*) which originally faced toward the median line (anterior leaflet) becomes the posterior parietal serous covering. The ascending colon at this stage has acquired a position which heretofore has commonly been called retroperitoneal. In the new-born always, and in the adult usually, after breaking through the line of adhesion between the anterior leaflet of the primitive mesocolon and the lateral parietal peritoneum, at the outer border of the colon (*a, e*), it is possible to separate the two fused layers and re-establish the primitive mesocolon. Some modern anatomists maintain the view that the colon is never extraperitoneal, inasmuch as there exist two fused peritoneal layers between this viscus and the posterior abdominal wall. The interpretation of the term "retroperitoneal" has served as a constant source of contention between the surgeons and the anatomists who have discussed cæcal hernia. It therefore seems wise to reserve the terms "retroperitoneal" and "ex-

traperitoneal" for those viscera (as kidneys, ureters, bladder, etc.) which, while lying in partial contact with the peritoneum, were never surrounded by it, and to employ the terms "retroserous" and "extraserous" for those viscera (as ascending and descending colon, duodenum, pancreas, etc.) which at one time, for all practical purposes, might be considered as having been completely intraperitoneal, but which by fusion have lost their serous layer on one or more aspects. These terms will be employed with the above meaning in the remainder of this paper.

After the primitive ascending mesocolon becomes lost by fusion the colon is held in fairly close contact with the posterior abdominal wall. It may retain this position, or in later life the peritoneum at either side of the colon may elongate and form the adult or definitive ascending mesocolon.

The reflection of the peritoneum from the posterior surface of the lower end of the ascending colon is usually transverse and is commonly placed between a line on a level with the summit of the iliac crest and another line on a level with the anterior superior spine of the ilium (Treves). Ordinarily the obliteration by adhesion of the parietomesenteric peritoneal angle is incomplete at the lower end of the ascending colon, so that on an average its lowermost one and one-half inches (Treves) are entirely covered posteriorly by peritoneum and have no direct parietal attachment. It therefore resembles the cæcum, whose serous covering is derived from an outgrowth of the peritoneum forming the primitive mesocolon. When suspended by these attachments Treves found that the apex of the cæcum corresponds with a point a little to the inner side of the middle of Poupart's ligament. Sobotta locates the middle of the lower cæcal border at the midpoint of Poupart's ligament. The internal abdominal ring lies halfway between the anterior superior spinous process of the ilium and the symphysis pubis. The anterior surface of the cæcum when distended lies in contact with the anterior abdominal wall (Sobotta). It is therefore evident that the cæcum customarily bears an intimate relation to the internal ring.

Deviations from this position are not infrequent. If the colonic attachments are elongated or the cæcum itself unusually long the latter may rest in the true pelvis.

In nearly one-third of a series of 435 autopsies Robinson found that the cæcum occupied what he terms the potential position. The mobility of the cæcum was so great that it was found in diverse positions within the abdominal cavity; it could be made to touch every abdominal viscus and could enter any abdominal ring. The potential position is characterized by an unduly large cæcum; by the distal one to four inches of the ascending colon being free from posterior attachments, and entirely covered by peritoneum; and either by persistence of the primitive ascending mesocolon or by the presence of a well-developed definitive mesocolon.

Infrequently the peritoneum on the posterior surface of the cæcum undergoes the same process of fusion as occurs with the one layer of the primitive mesocolon, and the cæcum thus acquires an extraserosus position. According to Jonnesco this happens in 8 per cent. of cases, but it is considered a much rarer anomaly by most modern anatomists. Treves did not see a single example in 100 cases. Schultze states that the posterior coat may be wanting, and the cæcum is then adherent to the iliac fossa. Tuffier found the upper posterior one-third of the cæcum adherent to the abdominal wall in 9 adults and old men in a series of 120 autopsies at all ages. In the remaining cases the cæcum was completely free. Perignon found the cæcum always free in infants and adherent 7 times in adults. Legeue found the cæcum adherent 6 times in 100 infants. Huntington's book contains a photograph of a cæcum whose posterior surface is extraserosus. The older anatomists erroneously claimed that the cæcum is always extraserosus.

In view of the manifold possibilities in the anatomical relations of the cæcum it is not surprising that hernia of this viscus occurs in so many diverse forms.

The congenital form of cæcal hernia may originate in any one of three ways.

1. The mobility of the cæcum and its proximity to the

internal ring easily permit its entrance into a patulous vaginal process, either before or after birth, forming a congenital inguinal hernia. The cæcum itself is clothed throughout by peritoneum and lies within the hernial sac. The contents of the sac may be cæcum and appendix only, or there may in addition be parts of the ascending colon, small intestine, and omentum. Adhesions from inflammation of the sac, cæcum, or appendix may form subsequently and prevent reduction.

2. The cæcum may be actively drawn into the vaginal process by means of its excessively developed connections with the testicle. About the seventh month of intra-uterine life the testicle lies within the abdominal cavity near the internal ring. It is loosely attached to the posterior abdominal wall by its mesorchium. The two peritoneal layers of the mesorchium are continued upward as a peritoneal fold enclosing the spermatic vessels. This fold is designated the plica vascularis and on the right side terminates in the appendix, cæcum, ileum, or primitive mesentery. Wrisberg was the first to advance the theory that the descent of the testis exerted sufficient pull on this fold to drag the structures attached to its upper extremity into the processus vaginalis.

In many cases of congenital cæcocele which have come to operation or autopsy the plica vascularis has been observed extending from the cæcum or appendix to the testis and forming a ridge on the interior of the posterior wall of the sac.

In a young infant in whom this fold was not perceptible in the sac, Lockwood found that the muscular fibres of the gubernaculum extended above the testis and were inserted in the cæcum and posterior parietal peritoneum. His claim that these muscular fibres may play an important rôle in causing a hernia of the cæcum has been confirmed by other writers. While concurring in this theory for some cases Hutchinson and Piersol were unable in some foetuses to trace any direct connection between the plica vascularis and the cæcum.

3. When the cæcum descends to the iliac fossa as early as the fourth month adhesions may form between the cæcum

or appendix and the posterior parietal peritoneum covering the testis or gubernaculum. The subsequent descent of the vaginal process and testis will draw the cæcum into the inguinal canal, forming either a congenital or an infantile hernia.

That the descent of the cæcum within the abdomen is intimately associated with the descent of the right testis is further indicated by some cases of cryptorchids in which the cæcum is retained in the lumbar region and is connected with the testis by the plica vascularis.

By either the second or third mechanism, the cæcum may be drawn down to form a congenital sliding hernia of the intrasaccular or extrasaccular type.

Acquired hernia of the cæcum may be classified as (1) simple, and (2) gliding. The latter, called by the French "*hernie par glissement*," may be sub-divided into (a) the intrasaccular; (b) the extrasaccular or parasaccular; and (c) the sacless.

The simple acquired cæcal hernia is analogous to acquired hernia of small intestine or omentum. The herniated cæcum possesses an intact peritoneal coat and lies within the sac (Fig. 2). The cæcum, suspended from the colon, is free on all sides so that the finger introduced into the sac can be swept around its entire circumference. It is produced by the usual causes of hernia acting upon any one of the varieties of Robinson's "cæcum of potential position."

a. Gliding intrasaccular cæcal hernia may occur in two forms. In both the hernial sac is derived from the peritoneum of the abdominal paries; the cæcum possesses an intact peritoneal coat and lies within the sac. In the one variety the relations of the cæcum are the same as in the simple acquired hernia, except that its escape from the ring is due not to its "potential position," but to a ptosis of the colon and its attachments (Fig. 2). In the second form the cæcum is provided with a mesentery which appears as though inserted in the wall of the sac, and the circumnavigating finger encounters the obstruction caused by the mesocæcum along the interior of the posterior wall of the sac (Fig. 3).

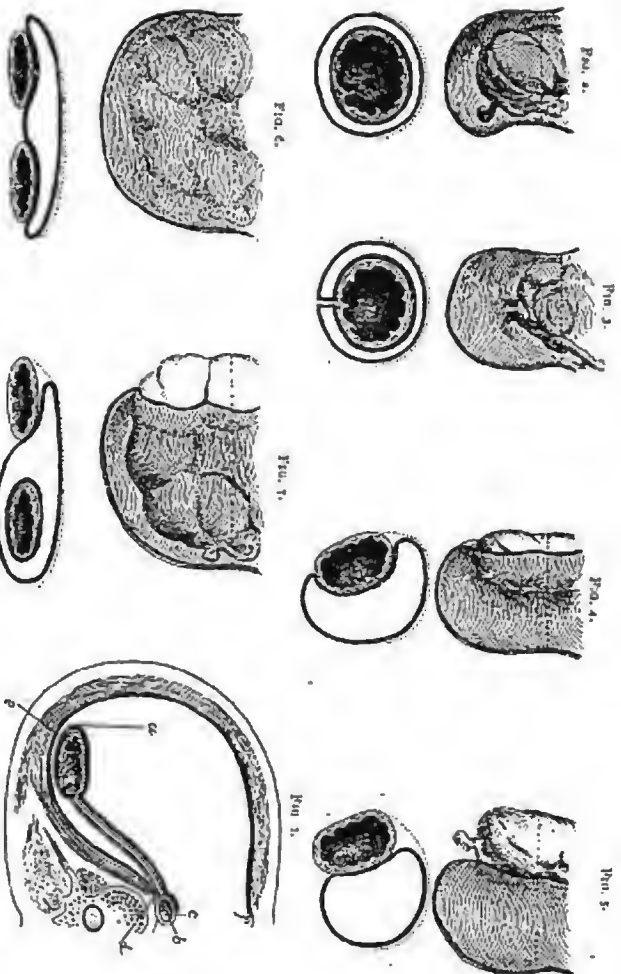


Fig. 1. Modified from Piccoli. By fusion between peritoneal leaflets *ab* and *cd* the colon becomes "retroperitoneal." Fig. 2. Intrascutular hernia with mesogastrium. The leaflets of the latter diverticulum are not readily apparent from the peritoneal cavity. Fig. 3. Intrascutular hernia with mesocolon. The leaflets of the latter diverticulum are not readily apparent from the peritoneal cavity. Figs. 4 to 7. The dotted line indicates the line of section in each continuation diagram. The lumen is omitted to avoid confusion. Figures 2, 3, and 4 may represent progressive stages in the development of a hernia.

b. In the extrasaccular or parasaccular hernia the cæcum is not contained within the sac, but lies on the postero-external sac wall, and can be exposed at operation or autopsy without the necessity of opening the sac (Figs. 4 and 5). On its posterior and external walls the cæcum is entirely bare of its serous layer and lies in direct contact with the cellular tissues of the inguinal canal and scrotum. The peritoneal coat on the antero-internal surface of the cæcum forms the postero-external wall of the sac and is directly continuous with the remainder of the sac, which is derived from the peritoneum of the abdominal parietes. Necessarily the antero-internal surface of the cæcum is adherent to the postero-external wall of the sac. Because the sac does not surround the cæcum many writers erroneously assume that only a partial sac is present. A complete sac can be found in every case in front and to the inner side or above the cæcum. The size of the sac often is insignificant in comparison to the size of the hernia. A small sac may contain only one or two inches of the distal end of the ileum, whereas an enormous sac may contain almost the entire gastro-intestinal tract and omentum. The entire appendix may have either an intrasaccular or an extrasaccular position, or part of the appendix, usually the base, may be intrasaccular and the remainder extrasaccular. Inside the sac the appendix retains its peritoneal layer, but outside the sac its serous coat is wanting.

c. Sacless Hernia.—The cæcum may escape from the internal ring minus its own serous covering, absolutely free from any structure even remotely resembling a sac, and without producing a rent in the parietal peritoneum.

The gliding cæcal hernias are produced by a ptosis or downward gliding not only of the cæcum but also of the colon, its attachments and vessels, and the posterior parietal peritoneum. They all descend to a proportionate extent so that the base of the ascending mesocolon (Treves's transverse peritoneal fold) will be found lying in the lower iliac fossa, inguinal canal, or scrotum, constituting an obstacle to reduction. Baumgartner has shown that there may be in addition a

downward displacement of the kidney on the same side, due to its peritoneal attachment, and of the aorta and inferior vena cava, due to their vascular connection with the ptotic gut. Bennett and Cunningham observed one case in which the ureter was dragged forward. Tuffier has frequently noted nephroptosis associated with hernia of the large intestine.

The relation of the peritoneum to the cæcum in the hernia is chiefly determined by their relation to one another before escaping from the hernial orifice. In their usual intra-abdominal relation the cæcum is completely surrounded by peritoneum except at its attachment to the colon, and does not possess a mesocæcum. By slight descent of the colon there is produced an intrasaccular hernia in which the cæcum does not have any connection with the sac (Fig. 2). A cæcum which possesses a meso within the abdomen will retain it as it passes through the internal ring, and there is produced a cæcal hernia having a mesocæcum the two leaflets of which diverge from a point behind the cæcum to be continued as the peritoneum forming the wall of the sac (Fig. 3).

From a retroserous position a slight descent of the cæcum permits it to escape by its uncovered surface from the internal abdominal ring. If only the denuded portion of the cæcum passes through the ring, that portion of the cæcum will form a sacless hernia. If more of the cæcum escapes from the hernial orifice, one of two things occurs. The parietal peritoneum (particularly on the anterior abdominal wall) may have a firmer attachment than the peritoneum covering the cæcum, in which case the serous coat of the cæcum will be retained inside the ring when the cæcum passes through, thereby forming a sacless hernia of the entire cæcum and appendix. The alternate filling and emptying of the cæcum drags upon the peritoneum and aids in the denudation. On the other hand, and this occurs more commonly, the cæcum in completing its descent will be accompanied by the peritoneum covering its anterior surface and by the layer of peritoneum which was originally reflected from the cæcum to the abdominal wall, thus creating a sac with the cæcum on

the outside—in other words, an extrasaccular cæcal hernia (Figs. 4 and 5).

Instead of forming the primary constituent of an acquired intrasaccular or extrasaccular hernia, the cæcum may escape from the abdominal cavity secondarily in any one of three ways. (1) The distal end of the ileum forms the hernia primarily and by its further descent and direct pull upon the cæcum drags the latter through the hernial ring; or again a loop of small gut or omentum after adhesion to the cæcum may act in a similar manner. (2) A hernia of the small gut or omentum forms primarily, and as it increases in size the posterior parietal peritoneum with the colon and cæcum is dragged down to form the enlarging sac. The anterior parietal peritoneum is much more firmly attached to the abdominal wall than is the posterior parietal peritoneum; hence an enlarging hernial sac is provided at the expense of the posterior parietal peritoneum, which in turn drags down the cæcum, and the very large hernias on the right side are therefore prone to contain the cæcum. (3) The cæcum and colon may descend to such an extent that the posterior surface of the latter viscus may be the first part of the gut to escape from the hernial orifice. It thus forms an angle with the cæcum which will be dragged into the hernia by its colonic end (Tuffier's "*hernie par bascule*"). If it retain its serous coat the cæcum will occupy an intrasaccular position and the colon may be either intrasaccular or extrasaccular, depending upon whether it possessed a mesocolon or was extraserosus before it began its descent. If the serous layer become detached from the cæcum as the latter passes through the hernial orifice there will be formed, depending upon the extent of the denudation, a sacless or an extrasaccular hernia of the cæcum and colon. In the reported cases the cæcum and colon have been observed repeatedly forming a U-shaped loop within the hernia (Figs. 6 and 7).

The surgeons, starting with the fact that upon incising the external oblique they have seen the muscular wall of the gut absolutely bare of any covering and lying in direct contact with the cellular tissues of the inguinal canal, go on to theorize

that the muscular coat must have been bare on its extra-serous aspect in the abdomen. The anatomists, starting with the fact that they are always able to find two fused peritoneal layers surrounding the extra-serous portion of the gut in the abdomen, propound the theory that these two layers must exist as a covering for the extrasaccular portion of the gut in the hernia. Going a step further Cavaillon and Le Riche maintain that it is possible to separate these two layers in the hernia in the same manner as is done in re-establishing the primitive mesentery in the abdomen, and by so doing the so-called sacless or extrasaccular cæcum will be found to lie completely within the sac and to have a complete peritoneal coat. All of the earlier anatomists and surgeons believed there was an unfolding of the peritoneal angle formed by the posterior leaflet of the primitive mesocolon (Fig. 1, *a, b*) and that portion of peritoneum lying posterior to it, whereby the colon and cæcum came to occupy a true "retroperitoneal" position. The unfolding was ascribed to the relatively less rapid growth of the peritoneum than of the colon itself (Treves, Macready), of the small intestine (Hutton), of the lateral walls of the abdomen (Luschka, Trietz), and of the right kidney (Waldeyer). Toldt was among the first to disprove this anatomical error on which the surgeons fixed their description of the mechanism of the production of the earlier cases of sacless and extrasaccular hernia.

So many surgeons have reported observations of the bare muscular wall of the large intestine in hernias that it seems incredible that all of them could have been mistaken. The proof by microscopical examination is wanting, but it seems fair to assume that such a condition may exist. On the other hand, the anatomists must be believed when they state that they always find the two fused layers of the peritoneum in the abdomen. The divergence of opinion arises when theories are formed, and inasmuch as the theories conflict with fact the theories need modification.

I have encountered cases in which the muscular structure of the cæcum was so plainly evident that it is inconceivable that

it was covered by more than a few, isolated shreds of tissue, to say nothing of a layer sufficiently developed to permit separation either in practice or in theory. In other cases the muscular structure of the intestinal wall was not apparent and appeared to be covered by a layer of connective tissue which possibly might permit separation into two layers. In the latter instances it seems probable that the cæcum retained its two fused layers during its descent, while in the former they were lost, possibly due to firmer union with the abdominal wall than with the intestine, or possibly due to their being stripped off, together with more or less of the peritoneum covering the front and sides of the cæcum, during the passage through the ring, by a mechanism similar to that of sacless hernia. In those individuals in whom the cæcum arrives at the iliac fossa at a comparatively early period of prenatal existence retrocæcal fusion may occur so early that the fused layers are feebly developed and are more easily detached from the cæcum, thus furnishing a predisposing factor. In the cases of intrasaccular cæcal hernia in which the sac is formed in part by a mesocæcum (Fig. 3) the two leaflets of the latter may be separated and the cæcum forced out between them by pressure from within the sac.

It is possible even in an intrasaccular hernia in which the cæcum does not have a meso but in which the posterior aspect of the cæcal end of the colon is extraserous, and this applies particularly to a "*hernie par bascule*," that pressure of the sac contents may extrude the cæcum from the sac and the peritoneal coat will be stripped from the cæcum in the same manner as a glove on being turned inside out is stripped from the hand. More or less of the cæcum, beginning at its posterior colonic end, will be deprived of its peritoneal coat, which goes to form the enlarging sac.

Cavaillon and Le Riche believe that the vascular connections between the cæcum and its peritoneum are too strong to permit its peritoneal denudation; but this again seems to be theory, as their argument is confronted by those cases of sacless hernia in which the peritoneum has undoubtedly been stripped from the anterior surface of the cæcum. The only ar-

gument advanced to explain the sacless cases by writers who deny that the cæcum can ever be bare of peritoneum, is that the sac has become obliterated by inflammatory adhesions between the cæcum and sac wall. No doubt this may occur; but the alterations would be sufficiently gross to be apparent, or at least to be unmistakable for bare muscle fibres. The question of the relation of the peritoneum to the cæcum in sacless and extrasaccular hernia cannot be settled definitely until more detailed study is made of specimens obtained at autopsy or removed at operation. Microscopical examination of the excised appendix in certain cases ought to aid very materially in the elucidation of the subject.

About one-sixth of the reported cases of all varieties of inguinal hernia of the cæcum were found on the left side. The disproportion between the two sides is undoubtedly greater in actual practice, as many writers reported in detail single cases of left hernia and merely mentioned having seen right cæcal hernias. Foerster was able to collect 54 cases of left cæcal hernia in 1901. Fifteen of the patients were under 10 years of age and 25 were over 45 years; 46 were males, 4 females, and in 4 the sex was not stated. Double inguinal hernia was present in 9 patients. Strangulation was noted in 12 cases, incarceration in 4, and irreducibility in 15. Complications may have been present in some of the remaining cases, the details of which were very meagre. Adhesions were found in 12 cases, and their absence was recorded in 8. The presence of a sac was noted in 28 cases, but the records fail to show whether the cæcum was intrasaccular or extrasaccular. The presence of the cæcum in a left inguinal hernia was ascribed to enteroptosis, transposed viscera, congenital left-sided position of the cæcum, the presence of a primitive or a long definitive ascending mesocolon, elongation of cæcum incident to old age, adhesion of cæcum to small intestine or omentum, and peritoneal traction exerted by huge hernia of the small intestines. In one case of scoliosis and another of kyphosis the spinal deformity may have been an etiological factor.

Left sacless and extrasaccular cæcal hernias are rarities and doubtless are secondary to transposed viscera or congenital malposition combined with fusion of the cæcal to the parietal peritoneum.

Congenital and acquired, both simple and gliding (intra-saccular, extrasaccular, and sacless) left inguinal hernias of the sigmoid and descending colon are not uncommon. I have never seen a left herniated cæcum, but have encountered twice the descending colon in a simple left inguinal hernia, once the sigmoid in a sliding left inguinal hernia, and once a long loop of the large intestine in a sliding interparietal hernia through a split in the left internal oblique and transversalis muscles on a level with the crest of the ilium.

The relative frequency of the various forms of hernia of the cæcum is indicated by combining the statistics of Hildebrand and Gibbon, who have collected 139 and 63 cases respectively, only 4 of which are duplicated. Of their 198 cases 128 were right inguinal, 24 left inguinal, and 12 were stated to be inguinal without specifying which side; 21 were femoral, 18 being on the right, two on the left, and one not specified; and 11 were umbilical. There was one case each of sacro-sciatic and of ventral cæcal hernia. In a collection of 135 cases of cæcal hernia Koch found the cæcum completely intra-saccular in 108, of which 86 were right and 22 left, and extrasaccular in one left- and 28 right-sided hernias.

In 417 cases of herniotomy collected by Brunner the large intestine was in the hernia in 6 per cent. and the cæcum in 2.3 per cent. Bennett found the cæcum present in 9 instances (1.59 per cent.) in a series of 565 successive cases of strangulated hernia at St. George's Hospital. At the Hospital for Ruptured and Crippled, Coley found in 2200 hernia operations the cæcum alone in 18, the appendix alone in 10, and the cæcum and appendix together in 7. Macready collected 51 cases of hernia of the cæcum, of which 36 were right inguinal, 9 left inguinal, 5 right femoral, and one left femoral. Baumgartner in 1905 was able to collect 159 cases of sliding hernia. Of these 64 contained the descending colon or sigmoid or both,

and with the exception of one left femoral hernia all were left inguinal. Of 14 cases of pure appendiceal hernia 4 were right femoral and 10 right inguinal. In 81 cases the cæcum alone or in combination with other portions of the intestinal tract and omentum was found as the contents of strangulated right femoral hernia in 2; of left inguinal hernia in 2, one of which was strangulated; and of right inguinal hernia in 75, of which 34 were uncomplicated, 22 were incarcerated or strangulated, 9 presented other complications, and 10 were found at autopsy. Of the entire 159 patients only 10 were females.

Of 108 cases of sliding hernia operated upon since the introduction of antiseptic and aseptic surgery Baumgartner found that 71 recovered without accident or recurrence, 18 recovered after various postoperative complications, 10 had incomplete operation or rapid recurrence, and 9 died.

In addition to the cases collected by Hildebrand and Baumgartner instances of sliding cæcal hernia have been reported by Berger, Bennett and Cunningham, Braun, Horrocks, Lawrence, Pelletan, and Wormald.

Femoral cæcal hernia is generally found in the female sex. Of the 21 cases of Hildebrand and Gibbon, 13 were in females, 4 in males, and in 4 the sex was not specified. This hernia is always acquired, and the cæcum may be intrasaccular, extrasaccular, or sacless.

Inguinal hernias of the cæcum are found at all ages, but are more common at the extremes of life. Baumgartner's cases included 27 patients over 60 years of age. Of Hildebrand's 80 cases of right inguinal cæcocele 12 were children under one year of age and 2 were fœtuses at the eighth month.

Aside from congenital cases, hernia of the cæcum almost invariably develops slowly. Austin reports a very exceptional case of sacless hernia which he operated upon for strangulation 65 hours after the hernia made its first appearance.

The symptoms of hernia of the cæcum are not characteristic. More or less severe symptoms of intestinal obstruction are not infrequent. Strangulation is uncommon. Irreduci-

bility was noted in a large percentage of the reported cases. In actual practice the percentage is undoubtedly smaller, as the reducible cases frequently escape observation. Acute or chronic inflammation or strangulation of the appendix is a frequent complication. Hydrocele is occasionally associated. Bennett had a remarkable case complicated by intussusception of the ileum through the ileocæcal valve.

The existence of the cæcum and appendix within a hernia usually cannot be determined prior to operation, but a few cases have been reported in children and in adults with thin overlying tissues in whom these structures were demonstrable by palpation. Morestin has suggested taking a skiagraph after the administration of bismuth as an aid in the diagnosis. Coley found that in some of the congenital cases the hernia could be reproduced after reduction by traction on the testis. Differentiation between intrasaccular, extrasaccular, and sacless hernia is not possible except at operation or autopsy.

Those congenital cases of cæcal rupture in which the hernia can be made to reappear by traction on the testis should be operated upon early. The pressure of a truss is prone to produce trouble. Barring the possible presence of adhesions, the intrasaccular form of cæcal hernia, whether congenital or acquired, does not offer any special operative difficulties. Adhesions of the appendix frequently necessitate its amputation before the sac can be excised.

In congenital cases in which a prominent peritoneal fold is present on the posterior aspect of the hernia, great care should be exercised in separating it from the underlying spermatic vessels. Neglect of this precaution has resulted in sacrifice of the testis in several instances.

The possibility of the intestine being unprovided with any serous covering should be borne in mind constantly at every operation for hernia, otherwise the intestine may be opened inadvertently in a search for the sac. The surgeon usually recognizes the fact that he is dealing with an anomalous hernia shortly after splitting the external oblique muscle. In those cases in which the two fused peritoneal layers are wanting the

extrasaccular portion of the intestine is readily recognized by its bare muscular fibres. When the two fused layers are present the extrasaccular portion of gut might be mistaken for a thickened sac. In case of doubt the hernia should be examined at once from its peritoneal side. Writers on cæcal hernia almost unanimously advise, as a safe procedure, incision of the sac at the upper inner side of the cæcum. The sac usually is encountered at this point; exceptionally, however, it may be entirely absent or, as in some few reported cases, the extrasaccular gut after torsion may lie in front of the sac, or in other instances the condition may be one of extraperitoneal hernia of the bladder and the incision recommended might prove disastrous.

No single region is suitable for incision in every instance, and the surgeon must use discretion as to the best site for opening the sac in each individual case. If the sac cannot be absolutely identified the structures about the internal ring should be retracted sufficiently to permit incision through normal anterior parietal peritoneum, when the sac and its associated viscera can be explored from the abdominal side.

In sliding hernias the mesenteric attachments of the ascending colon described by Scarpa as "the naturally fleshy adhesions" frequently prevent reduction until they are stripped loose from the underlying cellular tissues of the scrotum or inguinal canal in the same manner as they are stripped from their normal position in the iliac fossa in exposing the ureter.

In some cases the line of cleavage is obliterated by inflammatory adhesions, rendering the mobilization of the gut extremely difficult. The blood-vessels supplying the colon, which originally coursed between the two leaflets of the primitive mesentery, will be found occupying an extrasaccular position on the posterior wall of the sac at the inner side of the colon. These vessels must be respected or the vitality of the gut will be jeopardized. If the separation of the gut and sac from the subjacent structures necessitates cutting it should be done at the expense of the cellular tissues and as far from

the vessels as is practicable. Some surgeons advise a herniolaparotomy for those cases in which the line of cleavage is indeterminate in order to begin the stripping from within the abdomen. No attempt should ever be made to dissect the sac from the cæcum.

Various methods have been proposed for dealing with the sac and extrasaccular intestine. Berger resects the sac and adjacent peritoneum and covers the denuded intestinal surface by introducing a few sutures to form a mesocæcum, the two leaflets of which are obtained by folding back the uncut parietal peritoneum at each side of the gut. Care should be taken to avoid the colonic vessels in passing the sutures through the inner leaflet. He then reduces the hernia into the peritoneal cavity and employs a stout suture to close the neck of the sac, which is drawn upward and secured by passing the ends of the suture through the deep muscles of the anterior abdominal wall (Barker method). Morestin does a herniolaparotomy, constructs a mesocæcum in the same manner as Berger, and performs an indirect colopexy by suturing the base of the leaflets to the iliac fascia.

In order to cover the denuded surface of the intestine, which at times is thinned out or may be damaged at operation, Van Heuverswyn, Morris, Gouillard and Raffin, Tuffier, Wier, and Singley advise forming flaps of peritoneum from the sac wall along each side of the gut, turning them back, and suturing them together along the posterior aspect of the intestine before closing the neck of the sac. By this method the weak part of the intestine is reinforced and the gut is entirely surrounded by peritoneum, so that after reduction it floats free in the peritoneal cavity, and in the event of further gliding the direction of the descent is supposed to be deflected away from the inguinal ring.

The method, however, has certain objections. Any attempt to employ it to cover the posterior surface of either the ascending or descending colon seriously endangers the blood-vessels which pass obliquely outward to the colon immediately beneath the peritoneum from which the inner flap is formed.

If the vessels escape injury during the requisite dissection they will be distorted by the turning back of the flaps. This objection does not apply when the plastic operation is confined to the cæcum itself.

When the colon or the cæcum and ascending colon form an intestinal loop in the hernia the blood-vessels lie between its two limbs and will escape injury if the one pair of flaps is made to cover both limbs of the loop, as in Morris's case, but the flaps then tend to hold the gut in its kinked position and may cause intestinal obstruction after reduction. Transplantation of peritoneal flaps whether on the cæcum or the colon or both lessens but does not abolish the risk of perforation; and if infection from damaged gut or perforation does occur it is sure to be intraperitoneal, where otherwise it probably would be extraperitoneal.

Jaboulay, in the "*hernie par bascule*," reduces the colon first and then the cæcum, this being in the reverse order of their descent. Roussel at autopsy and Savariaud at operation saw the mesocolon reform from the peritoneum of the sac wall after reduction of the colon into the abdomen. Their experience indicates the advisability of preserving all the sac in moderate-sized hernia and doing only a partial resection in cases of very large sac.

Recurrences following operation have happened so frequently that some authors advise castration in order to make complete closure of the hernial canal, and others advise herniolaparotomy to permit of direct colopecty. Other surgeons point out that Barker's method of dealing with the sac as employed in these cases by Berger serves to suspend the colon, through its intimate attachment with the peritoneum at the neck of the sac. In many cases the redundant part of the sac was excised, the peritoneum closed by suture or ligature, and the extrasaccular loop simply reduced into the abdominal cavity, with retention of its extraserous position, with a happy result.

Dense adhesions and operative complications, particularly hemorrhage, have led many competent surgeons to refrain

from complete reduction of sliding cæcal hernia in several instances.

Gangrene of the bowel may necessitate resection of the cæcum, colon, or small intestine. Appendectomy, if indicated, should be performed after the sac and intestine are mobilized in order to prevent the tearing out of the intestinal suture.

No single method of dealing with the sac and intestine is applicable for all cases, and the surgeon must be guided in making his choice by the conditions in each individual patient. The sacless hernias are always small, but usually it is possible, if deemed advisable, to secure a peritoneal covering by slight modification of Berger's method of forming a meso for extra-saccular hernia.

After reduction the parietal wound may be closed by any of the usual methods applicable for inguinal hernia.

REPORT OF CASES.

CASE I.—Male patient, 38 years of age, admitted to University Hospital, May, 1905. Hernia accidentally discovered during childhood. Irreducible past 10 years. Sudden painful increase in size 48 hours before admission.

On examination presented right oblique inguinal hernia, size of cocoanut. Irreducible. Dull on percussion. Sac contents chiefly thickened omentum, which was excised. Testicle occupied bottom of sac. Appendix and lower half of cæcum adherent along posterior wall of sac. A thickened fold of peritoneum and fibrous tissue extended from tip of appendix to point on sac wall near testis. Appendix excised. Lower portion of sac preserved as tunic for testis, remainder resected. Normal convalescence. When seen one year later no sign of recurrence and constipated habit present before operation relieved.

CASE II.—Male, Russian. Age, 34 years. Admitted to Philadelphia Hospital, March, 1907. Reducible right oblique inguinal hernia of several years' duration. Percussion note dull in scrotum, tympanitic at external ring. Sac contents: anteriorly omentum, posteriorly non-adherent cæcum and appendix. Postoperative phlebitis of pampiniform plexus, otherwise smooth course.

CASE III.—Male, aged 57 years. Admitted to Philadelphia Hospital, January, 1908. Reducible right indirect inguinal hernia

of 6 years' duration. Sac contents: thickened omentum, cæcum, and appendix adherent to one another but not to sac. Adhesions too extensive and firm to permit ready separation and were not disturbed. Two fenestrations formed by adhesions between omentum and cæcum were closed by omental sutures to guard against internal hernia. Normal convalescence.

CASE IV.—Male, 58 years. Laborer. Admitted to Phoenixville Hospital, June, 1908. Large bilateral oblique inguinal hernia. Left hernia for 39 years following fall from horse. Right hernia appeared several years later. Constipated for years. Left acquired hernial sac contained small intestine. Right sac contained omentum, cæcum, and appendix, which were adherent to one another and to sac wall, and a short loop of non-adherent small intestine. Excision of sac. Constipation relieved.

CASE V.—Fireman, aged 35 years. Admitted to Philadelphia Hospital, February, 1908. Reducible right oblique inguinal hernia. Sac contents: omentum, which was excised. An apparent thickening or fatty cord on posterior wall of sac on closer examination proved to be appendix, the peritoneal layer of which was reflected at each side to form part of sac wall. Tip of cæcum presented at internal ring and was extrasaccular. Appendectomy. Resection of sac. Slight superficial wound infection.

CASE VI.—Laborer, aged 38 years. Admitted to Philadelphia Hospital, June, 1904. Right oblique partially reducible hernia. On splitting external oblique cæcum and appendix exposed without opening sac. Lower end of colon and cæcum arranged in curve, convexity downward, with tip of cæcum directed toward median line. Inferior surface of cæcum and colon and all of appendix except one-half inch of its base entirely bare of serous covering. Muscular fibres of intestinal wall distinctly visible. No sac discoverable at this stage of operation. Forcible retraction of internal oblique and transversalis. Incision into anterior parietal peritoneum for digital exploration of sac. Finger entered small pouch or sac formed in part by serous coat of undenuded portion of the cæcum and lower colon and in part by the layer of peritoneum reflected from these viscera onto abdominal wall. Rudimentary sac was very minor part of hernia and was surrounded on its lateral and inferior aspects by colon and cæcum. Sac contained one-half inch of base of appendix and two inches of ileum. Ileum and intrasaccular portion of appendix possessed

normal serous coat. Further search for sac futile. Reduction of intestine caused unfolding of bend between cæcum and colon with obliteration of small sac containing ileum and appendix. Exploratory peritoneal wound closed with catgut. Convalescence normal.

CASE VII.—Fireman, aged 34 years. Admitted to University Hospital, April, 1906. Reducible right oblique inguinal hernia for 16 years. Onset of violent symptoms of strangulation six hours before operation. Hernia size of child's head. Constriction at external ring. Sac opened. Two feet of ileum intensely congested, thickened, and almost black. Bloody serum oozed copiously from strangulated loop, which was returned to abdomen. Drainage tube inserted through right rectus stab puncture two inches above pubis. Cæcum extrasaccular and destitute of serosa over greater part of its circumference. Appendix fully extended with tip projecting below external ring but not adherent to testis. Meso-appendix stretched out on each side of appendix and formed part of sac wall. Appendectomy. After suture of peritoneal opening cæcum remained lying in inguinal canal. Cæcum reduced. Free sero-bloody discharge from drainage tube. Absolute constipation for five days, then frequent stools of decomposed blood for three days. Recovery. Returned to work. Died one year later of heart lesion. No recurrence. No autopsy.

CASE VIII.—Coachman, aged 56 years. Admitted to Philadelphia Hospital, February, 1907. Huge bilateral indirect inguinal hernia. Left hernia duration 16 years, right 6 years. Truss treatment ineffective. Mild symptoms of incarceration for 48 hours. Right hernia tense and tympanitic and resisted taxis for several minutes. Left hernia considerably larger, but responded more readily to taxis. Complete reduction impossible due to lack of intra-abdominal space. Preliminary treatment by diet and by bandaging hernias. Simultaneous operation. Dr. Edward Martin operated on left hernia, which was composed of small intestine and aside from large size presented no unusual features.

On right side hernial sac contained appendix and small intestines. The cæcum and a loop of small intestine extrasaccular. Cæcum occupied position outside postero-external wall of sac. The extrasaccular loop of small gut encircled the exterior of sac midway of its lateral borders, passing around its posterior wall, fundus, and anterior wall. About three-fifths of the circumfer-

ence of this loop of small intestine was devoid of serosa, but remaining two-fifths was normally covered by its peritoneal tunic, and the latter formed part of the sac wall. The portion of sac wall lying between cæcum and extrasaccular small gut excised and margins of opening sutured. The extraserosus cæcum and small gut returned through the wide internal ring but great intra-abdominal tension caused their repeated prolapse and occasioned some embarrassment in placing the deep parietal sutures. Normal convalescence.

CASE IX.—Male, alcoholic, aged 60 years. Operation Philadelphia Hospital, May, 1905. Reducible direct right inguinal hernia of 18 months' duration. After division of external oblique and conjoined tendon the cæcum, appendix, and posterior lower end of colon, entirely free from any tissue covering their muscular wall, came into view. No sac discoverable. Examining finger passed through an exploratory incision in anterior parietal peritoneum failed to find any abnormal depression, plait, or fold in the peritoneum at any point in the vicinity of the ring. The peritoneum preserved its usual relation at the ileocolic angle, but from all other sides of ileum it passed directly to the abdominal wall. Ileum presented fallacious appearance of being inserted in anterior abdominal wall at the internal ring. Herniated cæcum was absolutely free from any adhesions and was easily reduced into abdominal cavity, but remained extraserosus. Edges of exploratory peritoneal incision closed with catgut.

Remarks.—With the exception of Case IV all of the above patients were treated on the service of Dr. Edward Martin, to whom I am indebted for the privilege of operating upon them and of reporting them.

In none of the cases was the diagnosis of cæcal hernia made before operation. In a few other cases an appendix-like structure could be palpated, but at operation it was found to be a thickened strand of omentum.

In Case V the cæcum could scarcely be regarded as forming part of the hernia, but the case is of interest in connection with this subject and is included as a case of intrasaccular appendiceal hernia. The cæcum was extraserosus and its further descent would have produced an extrasaccular

cæcocele. Microscopical examination of the excised appendix revealed a normal arrangement of its peritoneal coat.

Case I is an example of congenital sliding hernia; Case II is simple acquired (intrasaccular) cæcocele; Cases III and IV of acquired sliding intrasaccular cæcal hernia; Cases VI, VII, and VIII of acquired sliding extrasaccular cæcal hernia; and Case IX of sacless hernia. In all of the cases the parietal wound was closed by the Bassini method. In two of them (Cases IV and VI) the edge of the rectus muscle was sutured to the edge of Poupart's ligament to assist in closing the muscular defect. So far as known there have been no recurrences. Case IV in January, 1909, presented a bulging in the inguinal region due to muscular weakness or relaxation, but there was no true hernial protrusion.

Case V illustrates the need for care in applying the ligature at the neck of the sac. In every hernia operation the surgeon should bear in mind that the appendix, cæcum, or bladder may occupy a position where it is endangered by the proposed ligature, without causing any prominence on the interior of the sac, and on its exterior might easily be mistaken for fatty tissue. Forcibly dragging down of the peritoneum at the internal ring increases the danger of damage to these viscera.

In Case VII the changes due to strangulation of the intestine of only six hours' duration were most profound. On the fourth day the advisability of a second operation was seriously considered, but the threatening symptoms subsided the following day and convalescence was uninterrupted after evacuation of several stools composed almost entirely of decomposed blood.

Case VIII is noteworthy as it appears to be the only case on record in which a loop of small intestine, other than that immediately adjacent to the cæcum, has occupied an extrasaccular position. This loop may have been extraserous before entering the hernia, or its mesentery may have been unfolded at a later period by pressure from the gradually enlarging hernias.

In Cases III and IV the extensive dense adhesions probably resulted from appendicitis, although no history of an acute inflammatory attack could be obtained. The absence of adhesions to the sac in Case III is suggestive of the inflammation having preceded the hernia, in which case the more mobile omentum may have been an active factor in causing herniation of the cæcum.

In Case IV the extensive adhesions to the sac seemed to indicate their formation subsequent to the development of the hernia. There was partial obliteration of the sac cavity, due to adhesions between cæcum and sac wall; but even though such adhesions might cause total obliteration of the sac cavity it would not be mistaken for true sacless hernia as suggested by some anatomists. The obscured outlines of the appendix as seen through the overlying adherent peritoneum of the sac wall offered a startling contrast to the denuded appendix, as seen in Cases VI and IX. Another argument against the theory of adhesions between sac wall and the underlying viscera being responsible for the changes present in sacless hernia is afforded by Case VI. The intrasaccular portion of the appendix which possessed its normal peritoneal covering and was not adherent to the sac wall had a larger diameter than did the extrasaccular portion which had been deprived of its peritoneal tunic. Had the extrasaccular appearance been simulated by adhesion between sac and appendix this portion of the latter would have been covered by two fused layers of the peritoneum and presumably would have had a greater diameter than the intrasaccular portion covered by only one layer.

Case IX is an undoubted instance of true sacless hernia.

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